SNAKE RIVER SOCKEYE SALMON HABITAT AND LIMNOLOGICAL RESEARCH (ESA) 9107100

SHORT DESCRIPTION:
Investigate feasibility of enhancing forage resources of historic sockeye nursery lakes; if feasible, fertilize lakes; modify existing barrier dams and install smolt/adult weirs at sockeye nursery lake outlets to allow passage and enumeration.

SPONSOR/CONTRACTOR: SBT
Shoshone-Bannock Tribes
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SUB-CONTRACTORS:
Biolines, Montgomery-Watson Americas, Inc.

GOALS

GENERAL:
Maintains biological diversity, Maintains genetic integrity, Increases run sizes or populations, Adaptive management (research or M&E), Program coordination or planning

ANADROMOUS FISH:
Habitat or tributary passage

NPPC PROGRAM MEASURE:
7.5A.1

RELATION TO MEASURE:
This project evaluates the limnological attributes of historic Snake River sockeye salmon nursery lakes. Based on our research we are able to estimate carrying capacities of these systems in order to recommend stocking numbers for each lake as fish become available from the captive broodstock program. Without this data high stocking densities could result in a zooplankton crash which would reduce available habitat for sockeye for future years and impede recovery. To increase rearing habitat in historical areas we have removed one barrier and are in the process of constructing weirs that will allow us to evaluate pre-smolt survival and smolt outmigration. We have also initiated a lake nutrient enhancement project on Redfish Lake, with plans to enhance other nursery lakes when fish from the broodstock program become available. This

TARGET STOCK	LIFE STAGE	MGMT CODE (see below)
Snake River Sockeye	Spawning, incubation, juvenile rearing	L W S

AFFECTED STOCK	BENEFIT OR DETRIMENT
Kokanee	
Hatchery rainbow trout	N/A, only affects stocking rates

BACKGROUND

Subbasin:
upper Salmon River
Land ownership:
public
Habitat types:
spawning, incubation, juvenile rearing

HISTORY:
Project was started to monitor and enhance (if necessary) sockeye nursery lake habitat and to restore juvenile and adult sockeye passage to historic habitat in the Sawtooth Valley of Idaho. Limnological and fish life history studies, in preparation for lake nutrient enhancement, were conducted from 1992 through 1996. Effects of different levels and applications of nutrient additions

were tested in 1993 and 1994. Redfish lake was fertilized in 1995 and 1996. Monitoring and evaluation of lake fertilization is ongoing. In 1995, the migration barrier on the outlet of Pettit was modified to facilitate outmigration, and a weir was constructed to enumerate outmigration of juvenile sockeye.

PROJECT REPORTS AND PAPERS:

1992 Annual Report (DOE/BP-22548-1), 1993 Annual Report (DOE/BP-22548-2), 1994 Annual Report (DOE/BP-22548-3), and 1995 Annual Report (DOE/BP-22548-4) are available.

ADAPTIVE MANAGEMENT IMPLICATIONS:

1. Limnological variables and fish interactions (competition/predation) are used to estimate sockeye carrying capacity. Lake carrying capacity information is crucial in developing release strategies for juvenile sockeye. The limnology data also provided the ground work for lake fertilization projects.
2. Fish community studies have lead to changes in the way non-listed fish species are managed in the Sawtooth Valley Lakes. Kokanee numbers are being reduced to make room for sockeye and hatchery rainbow trout stocking practices are being altered to minimize potential impacts with juvenile sockeye.

PURPOSE AND METHODS

SPECIFIC MEASUREABLE OBJECTIVES:

Reestablishing a naturally-spawning run of sockeye salmon to the Sawtooth Valley of Idaho that will meet delisting criteria for Snake River sockeye salmon and modest harvest goals for tribal members.

CRITICAL UNCERTAINTIES:

It is unknown how the hatchery produced sockeye will perform. Only 4% of the hatchery produced sockeye released to Redfish in 1994 survived to outmigrate in 1995. The outmigration rate more than doubled for the 1995 release, possibly due to nutrient enhancement that year. It is also unknown if juvenile sockeye from Redfish Lake broodstock will succeed in other Sawtooth Valley Lakes. Smolt to adult return rates are beyond the control of this project yet are critical in its success.

BIOLOGICAL NEED:

As the number of returning sockeye adults has decreased over the years, the nutrients they brought back from the ocean have caused the nursery lakes, which are already highly oligotrophic, to become even less fertile. This problem is compounded by the fact that kokanee have replaced sockeye biomass in the nursery lakes utilizing existing resources. Without limnology studies and lake fertilization, supplementation projects may exceed lake carrying capacity for juvenile sockeye causing zooplankton crashes which would result in poor sockeye growth and survival. Fish community studies must be completed to minimize negative interactions. Also, non-game fish barriers prevent adult sockeye from entering historic Sawtooth Valley sockeye nursery lakes. Those barriers must be modified or removed to allow passage. Delisting goals can not be reached without increasing available spawning and rearing habitat.

HYPOTHESIS TO BE TESTED:

Will habitat enhancement projects in the nursery environments increase juvenile salmon survival and adult returns? Do rainbow trout and other non-native fish species that where introduced to the Sawtooth Valley Lakes negatively impact rearing conditions for juvenile sockeye? Will improved migration conditions in the Sawtooth Valley positively impact sockeye populations?

ALTERNATIVE APPROACHES:

The only other alternative would be to import out of basin stocks to the Sawtooth Basin. This approach is unacceptable as Snake River sockeye salmon are a specific ESU, and decades ago other stocks were tried without success.

JUSTIFICATION FOR PLANNING:

N/A, this project is primarily research and management oriented.

METHODS:

Lake Fertilization
To increase forage resources and survival of stocked sockeye, liquid fertilizer was added to the surface of Redfish lake in 1995 and 1996. Applications were by boat and occurred weekly starting at ice out and continued through October in 1995, and from August through October in 1996. The impacts of lake fertilization will be tested using a design reported by Stewart-Oaten et al. (1986) and repeated measures analysis of variance. Primary and secondary production in Redfish Lake will be compared to several control lakes also located in the Sawtooth Valley. Smolt survival and migration success will be compared with unfertilized years.

Barrier Modifications
In 1995, 8,572 juvenile sockeye were introduced to Pettit Lake. We evaluated in-lake survival and outmigration success via a weir in the outlet stream during April and May 1996. A subsample of smolts were PIT tagged to evaluate overwinter survival, downstream migration rates, and smolt to adult return ratios.

Fish Community Research
Sockeye and kokanee populations estimates are made using split beam hydroacoustic technology. Hydroacoustic surveys for Redfish, Pettit, Stanley and Alturas lakes are completed in September. Fry recruitment and spawning densities for kokanee populations are monitored with fry traps and by completing spawning surveys. Relative abundance and diet information for potential competitors and predators is collected using mid-water trawls and gill nets.

PLANNED ACTIVITIES

SCHEDULE:

Planning Phase **Start** 1/97 2 2/96 **End** 3/97 8/97 **Subcontractor** Montgomery-Watson Americas

Task 1. Develop fertilization strategies for Pettit and Redfish lakes (and potentially Alturas Lake) to provide forage resources for juvenile sockeye.
2. Design and initiate permit processing for a smolt/adult weir for Alturas Lake Creek outlet.

Implementation Phase **Start** 5/97 1/97 1/97 **End** 10/97 12/97 **Subcontractor** Biolines

Task 1. Apply nutrients to Redfish and Pettit lakes (and potentially Alturas Lake)
2. Continue limnological monitoring programs in nursery lakes to evaluate nutrient enhancement program.
3. Continue fish community research to evaluate inter and intra specific interactions between Snake River sockeye and other fish species.

O&M Phase **Start** unknown **End** 12/97 **Subcontractor** Montgomery-Watson Americas

Task Construct sockeye juvenile/adult monitoring weir on Alturas Lake Creek.

PROJECT COMPLETION DATE:
Ongoing

OUTCOMES, MONITORING AND EVALUATION

SUMMARY OF EXPECTED OUTCOMES

Expected performance of target population or quality change in land area affected:
Increasing available habitat, lake nutrient enhancement, reduction of competitors, and supplementation projects will increase sockeye smolt numbers and theoretically adult returns. These efforts should prevent extinction, but recovery goals can not be reached without increased smolt to adult survival.

Present utilization and convservation potential of target population or area:
Historic Snake River sockeye nursery lakes are being evaluated to estimate the maximum potential for use in outplanting fish from the captive broodstock program. Presently nutrient additions are planned for at least two (Redfish and Pettit) of the lakes to increase carrying capacity. Early results from nutrient additions in Redfish Lake indicate higher overwinter survival of sockeye juveniles when nutrients were applied.

Assumed historic status of utilization and conservation potential:
Past data documents over 4,000 adult sockeye returned to Redfish Lake in 1955 (Bjornn et al. 1968). There is no documentation available of adult returns for the four other Sawtooth Valley lakes since the late 1800's.

Long term expected utilization and conservation potential for target population or habitat:
A viable population of sockeye in at least three of the five original Sawtooth Valley nursery lakes as identified in the Proposed Recovery Plan for Snake River Salmon (Schmitten et al. 1995). Anticipating improvement in survival of juveniles and adults through the mainstem corridor would lead to numbers of returning adults increasing to the point of reaching delisting criteria.

Contribution toward long-term goal:
Increased survival and improved migration conditions during the freshwater life stages of Snake River sockeye salmon.

Indirect biological or environmental changes:
A decrease in kokanee populations as sockeye populations increase.

Physical products:
Installation of a smolt/adult monitoring weir on the outlet of Alturas Lake. The number of captive broodstock progeny to be stocked in each lake are unknown at this time so the number of fish to be PIT tagged at the weir is also unknown.

Environmental attributes affected by the project:
Nutrient additions will increase the productivity of the oligotrophic nursery lakes in the Sawtooth Valley.

Changes assumed or expected for affected environmental attributes:
Long term changes should be minimal in the environment as the balance between sockeye and kokanee revert to historic ratios.

Measure of attribute changes:
N/A, this project concentrates on the lentic environment which should not affect sedimentation.

Assessment of effects on project outcomes of critical uncertainty:
Monitoring of smolt outmigration will show if nutrient enhancement has improved survival of juvenile sockeye. Limnological monitoring will show the effects of nutrient additions at different trophic levels.

Information products:
Results of all work performed on this project are discussed at monthly Technical Oversight Committee meetings and presented in an annual report to the Bonneville Power Administration.

Coordination outcomes:
The Snake River sockeye recovery project is an inter-agency program. Because of the nature of the program, with each agency responsible for a certain component of the overall program, coordination is essential for overall success. This coordination is accomplished through the Technical Oversight Committee where researchers exchange results, plan and coordinate activities, and express ideas and suggestions for discussion.

MONITORING APPROACH
(See Methods section)

Provisions to monitor population status or habitat quality:
Limnological monitoring concurrent with fish community research allows us to evaluate the effects of nutrient additions and stocking of sockeye broodstock progeny to the lake environment

Data analysis and evaluation:
Various statistical analyses will be used to analyze different components of the lakes' environment (i.e. zooplankton density vs o. nerka density, chlorophyll vs phytoplankton, etc.) as well as inter annual comparisons.

Information feed back to management decisions:
At the Technical Oversight Committee meetings.

Critical uncertainties affecting project's outcomes:
In 1996 we implemented a live feed training experiment on sockeye fry in the hatchery trying to improve the ability of the fish to forage more successfully in the wild. If survival after release into the lakes is still unsatisfactory, another method may be necessary.

EVALUATION
Completion of a smolt/adult weir on the outlet of Alturas Lake. Successful survival and outmigration of broodstock progeny.

Incorporating new information regarding uncertainties:
At the Technical Oversight Committee meetings.

Increasing public awareness of F&W activities:
We have had public meetings in 1995 and 1996 to explain the project goals and what we are doing to reach them.

RELATIONSHIPS

RELATED BPA PROJECT	RELATIONSHIP
9204000 Redfish Lake Sockeye Captive Broodstock Program	Results generated by this project (e.g., lake fertilization) help direct decision making processes that relate to how many, when, and where sockeye produced from the broodstock programs should be released.
9107200 Idaho Department of Fish and Game Sockeye Salmon Captive Broodstock Program	Results generated by this project (e.g., lake fertilization) help direct decision making processes that relate to how many, when, and where sockeye produced from the broodstock programs should be released.

RELATED NON-BPA PROJECT	RELATIONSHIP
	N/A, BPA sole funding source

OPPORTUNITIES FOR COOPERATION:
The Shoshone-Bannock Tribes' personnel involved with this project work closely with their counterparts in the IDFG. Mutual cooperation is evident by the coordination of field activities and the sharing of equipment and manpower. We also donate and receive help from other salmon projects within our own Department.

COSTS AND FTE

1997 Planned: $600,000

FUTURE FUNDING NEEDS:

FY	$ NEED	% PLAN	% IMPLEMENT	% O AND M
1998	$900,000	10%	60%	30%
1999	$700,000	5%	70%	25%
2000	$600,000	5%	70%	25%

PAST OBLIGATIONS (incl. 1997 if done):

FY	OBLIGATED
1991	$257,575
1992	$385,732
1993	$458,407
1994	$486,618

2001	$600,000	5%	70%	25%	1995	$823,035
2002	$600,000	5%	70%	25%	TOTAL:	$2,411,367

Note: Data are past obligations, or amounts committed by year, not amounts billed. Does not include data for related projects.

OTHER NON-FINANCIAL SUPPORTERS:
The Sawtooth Wildlife Council supports efforts by the SBT to recover Snake River sockeye.

LONGER TERM COSTS:
Due to uncertainties about the duration of lake fertilization it is unreasonable to estimate that far in the future.

1997 OVERHEAD PERCENT: 26%

HOW DOES PERCENTAGE APPLY TO DIRECT COSTS:
Personnel only

CONTRACTOR FTE: 4

SUBCONTRACTOR FTE: 6